

# Maize and Hemp as Energy Crops in Northern Latitudes

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## INTRODUCTION

Prerequisites for sustainable energy production are high biomass and low inputs. Quality of the biomass is also a significant factor, since bioenergy technologies have different requirements for raw material. Sugars and starch are important in fermentation methods, whereas in combustion processes, alkali metals and silicon cause slagging and corrosion. Plant species, genotypes, environment, and management practices influence biomass and its quality.

## MATERIALS

Maize (*Zea mays* L.) and hemp (*Cannabis sativa* L.) were grown in 2007-2009 at Viikki Experimental Station (60°13'N), Finland. Maize was grown in 20 m<sup>2</sup> and hemp in 10 m<sup>2</sup> plots with 120 and 60 kg N ha<sup>-1</sup>, respectively. Samples of 1 m<sup>2</sup> were harvested once a month during the growing season and once after winter. The chemical composition and energy content of the samples were analysed from dried samples with ICP-OES (Al, B, Ca, Cu, Fe, K, Mg, Mn, P, S, Si, Zn), chloridometer (Cl), VarioMax CN analyzer (C, N), muffle furnace (ash), and calorimeter (energy content).

## RESULTS

Maize and hemp dry matter yield varied widely from year to year depending mainly on weather conditions (Table 1). Hemp accumulated less K and Cl than maize (Figure 1), in which these elements were mainly localized in basal parts of the stem and in the ear. The element concentrations decreased during winter probably due to retting. Spring harvested material comprised mainly lignocellulose (data not shown). The energy content of both crops is high. Maize has higher content of soluble sugars in comparison to hemp.

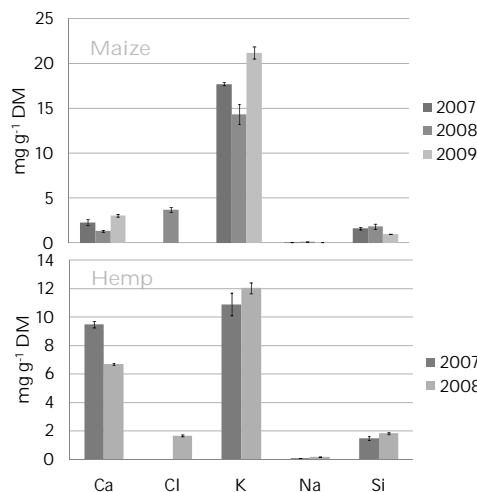


Figure 1. The element content of maize and hemp dry matter.

## DISCUSSION

Autumn harvested biomass is most suitable for methane and ethanol production due to high water content. Spring harvested crops are more suitable for combustion and pyrolysis. The content of soluble sugars in maize are quickly digestible unlike in hemp. The energy content in maize is high, although the management inputs in form of nitrogen are also higher in comparison to hemp. Therefore, hemp has better energy balance.

Table 1. The dry matter yield, energy, water and ash content of maize and hemp.

Crop	Year	DM, t ha <sup>-1</sup>	Energy, MWh ha <sup>-1</sup>	Ash, %	Soluble sugars, t ha <sup>-1</sup>	C/N
Maize	2007	20.0 ± 0.6		5.7 ± 0.4	3.90 ± 0.12	27.1 ± 0.2
	2008	13.4 ± 0.7	38.4 ± 0.1	5.9 ± 0.3	2.68 ± 0.21	28.1 ± 0.4
	2009	25.1 ± 0.4	76.6 ± 3.8	4.2 ± 1.8	4.04 ± 0.24	35.0 ± 0.4
Hemp	2007	6.4 ± 0.5	34.5 ± 0.1	6.8 ± 0.2	0.08 ± 0.02	25.5 ± 0.5
	2008	14.2 ± 0.2	51.1 ± 0.1	3.5 ± 0.1	0.72 ± 0.01	62.0 ± 2.7